



Kettle Pond Vegetation Monitoring

Background

Scattered throughout Cape Cod National Seashore are numerous freshwater lakes and ponds of glacial origin. Collectively known as “kettle ponds”, due to their roughly circular shapes, these waterbodies were created by melting blocks of glacial ice that left depressions on the outwash plain nearly 18,000 years ago. As sea level rose and pushed the groundwater table up, these depressions became flooded. Depending on land surface elevation relative to groundwater elevation, seasonally- or permanently-flooded ponds have developed. The latter are known as kettle ponds and there are 20 such ponds within CACO in the towns of Truro and Wellfleet.

Kettle ponds provide critical habitat for a variety of plant and animal life. A number of aquatic plant species designated by the State of Massachusetts as Endangered, Threatened, Special Concern, and Watch Listed occur around pond edges. The ponds are also major attraction for humans. With this brings a number of concerns including trampling and denudation of shoreline and littoral zone vegetation, erosion, bather urination, and septic effluent from houses surrounding the ponds that add nitrogen and phosphorus to the system. There are also biotic threats to pond communities - especially exotic plant species such as *Phragmites australis* (common reed) and *Lythrum salicaria* (purple loosestrife). In Massachusetts there are many species of invasive submerged aquatic vegetation (SAV), which have not yet been found in the kettle ponds but are an ongoing concern.

Long-Term Monitoring

Vegetation tends to integrate a variety of physical, chemical, and biological factors over time and is therefore a good indicator of long term change in pond environments. In 1995, Roman et al. (2001, *Hydrobiologia*) developed preliminary methods to assess plant communities and determined that the vegetation reflected the trophic status of 5 ponds. In 2005 and 2010, their study sites were re-surveyed, the scope of monitoring expanded from 5 ponds to 10, additional box-plots added, and pond-wide plant inventories included. Vegetation surveys are scheduled to be repeated every 5 years as a way to document spatial and temporal changes in aquatic plant communities.



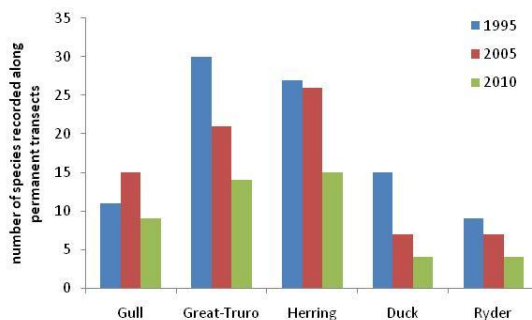
Sagittaria teres
(favored by exposed shoreline)



Utricularia radiata
(favored by high water levels)

Status and Trends

Taxonomic composition showed a statistically significant change between 1995 and 2010 in 4 of the 5 original ponds surveyed. Species richness also has apparently decreased over time (Figure below). Given that the nutrient status of these ponds does not appear to have changed much (according to pond water quality monitoring data), this may be due to prolonged high water levels since the original 1995 survey was conducted during which values were substantially lower at this time (although Gull and Herring ponds exhibit this to a lesser extent). During low water years, a greater variety of plants can emerge from the exposed pondshore sediments. During high water years, emergence of many species is suppressed, while others, such as *Nymphaea odorata* (white water lily) or *Utricularia* spp. (bladderworts) may proliferate. Subsequent surveys (every 5 years) will allow us to assess whether this turns out to be a real long term trend.



Total number of species (all transects pooled by pond) in 1995-2010

	Pond stage (m-MSL)						
	1995	2005	2006	2007	2008	2009	2010
Duck	2.30	2.97	2.94	2.61	2.5	2.55	2.92
Great (T)	2.00	2.87	3.04	2.71	2.63	2.76	2.87
Gull	1.98	2.00	2.01	1.97	2.07	2.01	2.00
Herring	1.90	1.94	2.00	1.92	1.96	1.94	1.93
Ryder	1.80	2.37	2.63	2.25	2.19	2.31	2.48

Mid-August pond stage by year

Management Applications

CACO's kettle ponds can potentially be managed in very tangible ways. For example, human access and foot traffic can be controlled to limit disturbance and development and land use practices in the watershed could be managed in various ways. In general, the preservation of native pondshore plant communities, particularly as it relates to state-listed rare species and infestations of invasive species, is a high priority. In addition, any shifts in plant communities that indicate rapid changes in trophic status would provide valuable information for determining whether human-related impacts on hydrology and/or nutrient cycles are occurring and whether management actions might be taken to ameliorate the effects.

Cape Cod National Seashore

Resource Brief

National Park Service
U.S. Department of the Interior



More Information

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